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ABSTRACT

During 1975, the Educational Satellite Communications Demonstration (ESCD) used the Applications Technology Satellite #6 (ATS-6) for three distinct demonstrations in Appalachia, Alaska, and the Rocky Mountain area. The most common use of the technology was to broadcast an uninterrupted program followed by a short interaction period. Other adaptions included the development of a central tape distribution center, accumulation of recorded programs for rebroadcast in individual schools or for whole school districts, and the generation of programs on a local basis. Educational programs proved successful with adult students, but the project received mixed reviews from younger students and from teachers. The project served to demonstrate some uses of the technology, but the cost effectiveness and the educational effectiveness of the design needs to be further explored. (EMH)

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THE NATIONAL INSTITUTE OF EDUCATION'S EDUCATIONAL SATELLITE COMMUNICATIONS DEMONSTRATION: LESSONS LEARNED AND THEIR FEDERAL POLICY IMPLICATIONS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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PREFACE

Mr. Feiner of Practical Concepts Inc. has done enough stage-setting for me to focus on just the lessons learned from the ESCD projects in the Rocky Mountains area and Appalachia. These lessons help us answer the key policy questions: should the federal government support the development of a satellite network based on small inexpensive earth stations and used to deliver broadband within the continental U.S.; could such a network be a viable self-sufficient entity; and is there an educational need for such a network's services?

No case has to be made for the need for satellite telecommunication to deliver social services to remote communities in the Alaskan bush. However, in the continental U.S. social service delivery systems are highly advanced and already use terrestrial communications as much as they seem to need to. Of course, satellite telecommunications might just be a cheaper way to deliver social services. But the prior issue is whether satellite technology can be used to do educationally good things that cannot be done with terrestrial communications systems. It is this issue that I will focus on here.

I. INTRODUCTION

The National Institute of Education's (NIE) $17 million Educational Satellite Communications Demonstration (ESCD) used NASA's Applications Technology Satellite #6 (ATS-6) during Fiscal Year 1975 for three distinct demonstrations in Appalachia, Alaska, and the Rocky Mountains area. All three broadcast broadband instructional television (ITV) in the 2.5 GHz band over the high-powered ATS-6 directly to inexpensive 10 ft. diameter antennas and receivers which were located near the classrooms using the ITV. The ESCD's students ranged from adult teachers in Appalachia to Junior High students in the Rocky Mountains area to primary grade students in Alaska. The receiving sites tended to be located in the remote and isolated parts of their respective regions.

Because of the ESCD's brief one-year operational period, and because of the novelty of direct ITV broadband broadcasts to remote schools via satellite, the ESCD was more a technology demonstration than an educational experiment. The project succeeded in demonstrating the technical and organizational feasibility of broadcasting broadband ITV directly to inexpensive earth stations at remote schools widely dispersed throughout large multi-state regions.

II. DIFFERENT EDUCATIONAL USES OF BROADBAND SATELLITE COMMUNICATIONS

The ESCD did not put to rest certain educational issues about satellite telecommunications. Before turning to what the ESCD said about these issues, it is helpful to conceptualize different educational applications of communications satellites under four educational headings. By way of analogy with familiar ways of organizing instruction, we call these applications.

1. "the network lecture-hall,"
2. "the network library,"
3. "the network of local community libraries," and
4. "the network of school libraries."

A. The Network Lecture-Hall

The most common use of the satellite during the ESCD was an uninterrupted televised program followed by a shorter interaction period. It can best be grasped by imagining a large auditorium of the kind used for political conventions, with microphones spaced throughout the hall. Small groups clustered around each microphone could secure access to the hall's loudspeaker system when allowed to do so by the speaker at the podium. The speaker would complete his portions of the program and then open the meeting to questions from the floor, from one group at a time. Replace the podium with a broadcast studio, and imagine the small groups dispersed in classrooms across a region of thousands of square miles, and you have the ESCD's most typical "satellite classroom." In Appalachia, some of the microphones were teletype machines, but the general picture was the same.

B. The Network Library

The largest of the ESCD's demonstrations was the Satellite Technology Demonstration (STD) in the Rocky Mountains area. The STD's most popular component was it "Materials Distribution Service" (MDS). The STD's network production and transmission center in Denver had 400 titles of non-serial program modules available for the MDS. Teachers were provided with a catalog of program descriptions that were informative enough to obviate the need for teachers to preview the programs. Program schedules were developed for six week periods based on the numerical popularity of different library titles. Teachers got what they wanted if they wanted what others teachers in the network wanted. Teachers who wanted unpopular programs did not receive them.

This use of a satellite network as a centralized ITV resource center resembles the use of a large lending library in which materials ordered are delivered on request approximately when the user wants them. But a satellite-based network library inverts the book library's supply and demand relationship because, if satellite channel capacity is limited, then everyone promptly gets the items in demand by most users but items wanted by only a few teachers may never be sent.

It is reasonable to assume that schools able to buy a satellite terminal and pay for a network's services will probably also be able to buy a few videocassette recorders. So, as with a lending library, a network library's users can store and use tapes of broadcast programs for a few days or weeks before erasing them to record new broadcasts.

The network library is owned collectively by the network's member schools and functions as a cooperative rental system. It is expected that the full purchase price for a program owned by the whole network would be less than the full sum of the royalty fees charged to the member schools in the network were they to purchase their own copies of the program for private ownership.

C. The Local Control Continuum, and the Network of School Libraries

The network lecture-hall lies at one extreme in a continuum of different ways of organizing ITV distribution for instruction purposes. Different organizations can be ordered in the continuum according to how much control over classroom instruction they give to the local classroom teacher. The network library gives much more control and freedom to the teacher than does the network lecture-hall and so falls closer to the mid-point of the continuum.

At the other extreme of this local-control continuum lies the network of school libraries which requires that heavy use is made of videocassette recorders so that taped recordings of network broadcasts can be stored indefinitely on the school's premises. School libraries would grant maximum accessibility and flexibility at all times in the school year and, unlike the network library, school libraries would not require re-recordings of re-broadcasts of programs used every semester or more.

The chief disadvantage of a network of school libraries is its expense. The total number of tapes needed by a school in a network library would be smaller than the number needed in the school library system. Therefore, the

need for a short-term program rental arrangement in a network libary system is governed by the average school's expectations about (a) how important it is for a particular program to be available at every point in the semester, and (b) how often the school's teachers will continue to want and use the program over many years.

D. The Network of Local Community Libraries

This kind of organization lies somewhere between the network library and the network of school libraries on the "local-control" continuum. In this network of local community libraries, programs are broadcast to, and stored on tape at, cable head-ends, ITFS systems, and other small terrestrial distribution centers for re-distribution to member schools in the same geographical area. The cost of a satellite earth station could be shared among a consortium of local schools. The sizes of local community re-distribution systems might range from school districts to state ETV networks.

Each community library could tape and store those satellite broadcast materials most frequently wanted by its own schools, and each could tap the larger satellite network library for items needed less frequently and items wanted for only short periods of from one to four semesters. The satellite network library could serve different communities of schools which gradually change their educational goals and philosophies in mutually different ways at mutually different rates. Different communities could thus share with one another, the costs and risks of owning a great diversity of programs.

E. Local vs. Regional Production of New Courseware

The three ESCD projects produced their own ITV programs, often by using substantial amounts of pre-existing off-shelf materials which were edited and integrated into programs to meet the special needs of their TV courses. In the four kinds of satellite-based library organizations described above, the more schools that are served by any one ITV library in the network, the greater will be that library's ability to produce new courseware in response to the expressed needs of its users.

If homogeneous educational needs tend to cluster in distinct geographical pockets, then new production centers can be located at the local level. However, if homogeneous educational needs do not tend to be geographically defined but are instead aggregatable only across multi-state regions, then perhaps new-production centers should be located at the center of the satellite network.

III. WHAT DID THE ESCD SAY ABOUT THESE USES OF BROADBAND SATELLITES?

A. The Network Lecture-Hall

1. Adults

This organization worked well in the ESCD when the ITV shared responsibility for the instruction with the students, when the satellite lectures and classroom discussion were the chief teaching agents. It worked best with adult students who needed neither the personal contact nor structure provided by a local teachers.

Examples were the STD's 7-program course in emergency medical procedures for policemen, firemen, ambulance operators, and other health and safety workers, and the Appalachian projects teacher-training courses. The successes of both depended on the courses' professional advancement opportunities for the adult students.

However, these two cases did not show that the "live" quality of the satellite broadcasts was significant in contributing to student learning. Students in the Appalachian project "liked" the occasional "live" interactions with satellite teachers, but this result may not be transferrable from the Appalachin project's 300 student courses to satellite "classes" which enroll a thousand or more persons. (The larger enrollements are desirable to defray the very high fixed hardware and staff costs in a satellite network.)

2. Grades K-12

"Live" broadcasts in the STD's Junior High "satellite courses" were less successful. The "liveness" was found to be much less desirable than local control over the scheduling of the programs during the school day and the school week. Local teachers often resented the TV's competititon and its "same-for-everyone" type of instruction. They wanted the programs to be both shorter to permit adequate student preparation and follow-up discussion, and less frequent to permit more individualized learning during the school week. The "lock-step" serial nature of the courses kept all STD students at 56 schools in 8 states moving ahead in the course at exactly the same pace.

B. The Network Library

The STD's very popular Materials Distribution Service (MDS) was a multi-state ITV-cooperative rental service. STD teachers expressed high praise for the speed at which a request could be processed and the item delivered via satellite in comparison to the relatively sluggish services provided by traditional mail-delivered rental tape distributors. Teachers understandably liked getting what they wanted when they wanted it. The critical question here is whether the results of the 56-school STD network are transferrable to networks having 500 or more number schools. The trade-off is between the costs for many satellite channels on the one hand and the network's ability to respond over many channels to distinctive and unusual teacher preferences for individual programs on the other hand.

If different teachers in the network generally tend to want the same individualized programs at very different times in the semester, then the satellite network should be organized around local community libraries. A network library, on the other hand, is the best kind or organization (a) when the network's users are educationally homogeneous, (b) when they want non-serial modular TV "specials" which can be shown at just about any point in the progress of a course in the program's subject-area, and (c) when the programs are not wanted so frequently and for so many years that school will want to purchase copies for their own private library collections.

C. Network of School Libraries

The ESCD provided very little information about this way of using the satellite network. Those schools in the STD which used the MDS did express interest in keeping selected copies of broadcasts they had recorded for their own permanent private library collections. But this tells us little about when and where rapid deliveries for local permanent storage are educationally needed.

D. Network of Local Community Libraries

No local closed circuit redistribution systems participated in the ESCD in a Network Library mode, so it is still unclear whether consortia of schools could make good use of a satellite network.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

The ESCD appeared to indicate that a satellite-based broadband ITV network will impose too much uniformity and conformity to be attractive to educational users unless heavy use is made of videocassette recorders in member schools and unless the organization of the network is carefully shaped to fit the patterns of educational needs of its users. The network's organization should be shaped by those needs to take advantage of the network's most promising features:

1. rapid deliveries with minimum handling and bookkeeping,
2. economies of scale needed for collecting and producing a large variety of high quality programs.
3. its ability to aggregate together widely dispersed users who have similar but unusual educational needs, and
4. organizational flexibility for serving both isolated schools and different hybrids of terrestrial redistribution systems within the same network.

Organizational flexibility may be more fundamental than the other features since only by attracting and aggregating a broad range of users can a satellite-

based network become large enough both to take advantage of economies of scale and to aggregate sizeable demand for every program broadcast.

The key federal policy issue facing decision-makers today is whether there is a need for educational satellite communications. ITFS systems, state, regional, and national ETV networks, and distributors of rental mail-delivered videotapes have been serving the nation's ITV needs for some time and are continuing to grow. ITV distribution consortia of school districts are rapidly emerging. Is there a need for certain kinds of ITV services which are not, and will not be, met by existing systems but which can be met by a satellite network?

This paper has argued that the possibility of such a need is not unimaginable. But should federal agencies adopt a hands-off stance and let other national, regional, state, and local bodies determine the fate of educational satellites in concert with the commercial market place? Or should federal agencies intervene on their behalf by underwriting some of the start-up costs for an educational satellite network?

An argument against federal intervention can be based on a comparison to the decision to network the PBS stations via satelli e instead of via terrestrial communications. This argument asserts that costly new adventures with novel technology can only be justified by demonstrations of a clear and present economic need as was possible in the PBS case. For instance, if several major existing tape rental libraries were to merge and, with numerous local school district consortia and state systems, were to form a viable and self-sufficient network library based on mail-delivery, then the relative advantages of satellite delivery over mail-delivery could be properly assessed. But, if such a viable organization <u>were</u> formed, then it could probably also finance a satellite network without the help of federal intervention. This argument concludes that federal intervention is either premature or unnecessary.

If the existence of a potentially strong widespread need for the special advantages of a satellite network could be demonstrated, then federal inter-

vention might be warranted. The ESCD demonstrated that there might be a potentially widespread demand for a network library and for teacher in-service training. But since users in the ESCD were not asked to pay for the satellite services, there is no way to gauge the strength of the demand. So the existence of such a widespread need has not yet been demonstrated.

Can this need be demonstrated? Indeed, is this a normal researchable needs-assessment problem? The educational community is being asked to seriously evaluate a satellite-based ITV network that is put together in such a way that its best educational advantages are highly visible. But it is crucial that we ask educators to evaluate such a network in an operational real-world setting, not in the imaginations of their minds.

So the chief research questions, and therefore the chief policy questions, is whether an operational real-world network can be presented for evaluation to educators in such a way that the network's educational advantages are highly visible.

This may not be possible. A network will not appear to be educationally advantageous if the costs are high and if the network is not responsive to the distinct needs of most the individuals it is supposed to serve. But both of these drawbacks can be overcome only in very large networks. Here is the reason for this observation: the diversity of educational needs in a 500 school network will not grow ten-fold if the network grows into a 5,000 school network. Yet, the 5,000 school network will be able to finance close to 10 times as much communications capacity as the 500 school network. So if the diversity of needs grows more slowly than the delivery capacity, then larger networks will be more responsive to individualized education. For the individual consumer, it seems that the bigger the network the better, at least up to some still unknown point of diminishing returns.

This fact that a network's educational attractiveness is proportional to its size by itself seems to argue for federal intervention if only for

the purpose of clearly assessing the potential educational market for satellite services. But this seems to put the cart before the horse because the needs assessment is supposed to preceed the decision to support the development of an educational satellite network with federal dollars.

The logic of the foregoing dialogue about federal intervention instructs us to avoid a "frontal assult" strategy when approaching the policy area. The better strategy is to separate future federal policy decisions into two clusters: those decision which may need to be made soon and those decisions which can be safely postponed until better information is available.

The first issue requiring early decision is the use to be made of ATS-6 when it returns from India. If NIE intends to use ATS-6 again for another project, then it is recommended that great care be taken to make the project simulate as closely as possible the characteristics of a hypothetical fully operational satellite network serving the needs of a wide range terrestrial ITV systems in both a network library mode and a network of community libraries mode. In particular, users must be asked to pay a reasonable share of the costs of the satellite-delivered services, a share comparable to what they would have to pay in the hypothetical large-scale operational network.

A second issue warranting early attention is the allocation of spectrum space for future educational satellite broadcasting. The United States government must take a position on spectrum management before the 1977 and 1979 meetings of the International Telecommunications Union's World Administrative Radio Conference where domestic and world-wide reservations of spectrum space for various uses will be established or revised. Educators should have a voice in these decisions.

What decisions are safely postponable? Mostly, they fall under the heading of federal subsidies for the creation of an actual educational or public service satellite network. The idea of a public service satellite

network may have much to commend it. But the case for haste is not compelling. The possible cost advantages of a satellite network compared to those of existing and developing terrestrial communications systems are not so clear as to justify immediate decisions, much less require them. More importantly, there is even less clarity about whether there is or will be an educational need for a satellite network. Until a great amount of solid information can be assembled for illuminating the cost and educational need questions, the more prudent direction for federal policy to take is further comparative research into different ITV distribution organizations based on both satellite and non-satellite delivery technologies.